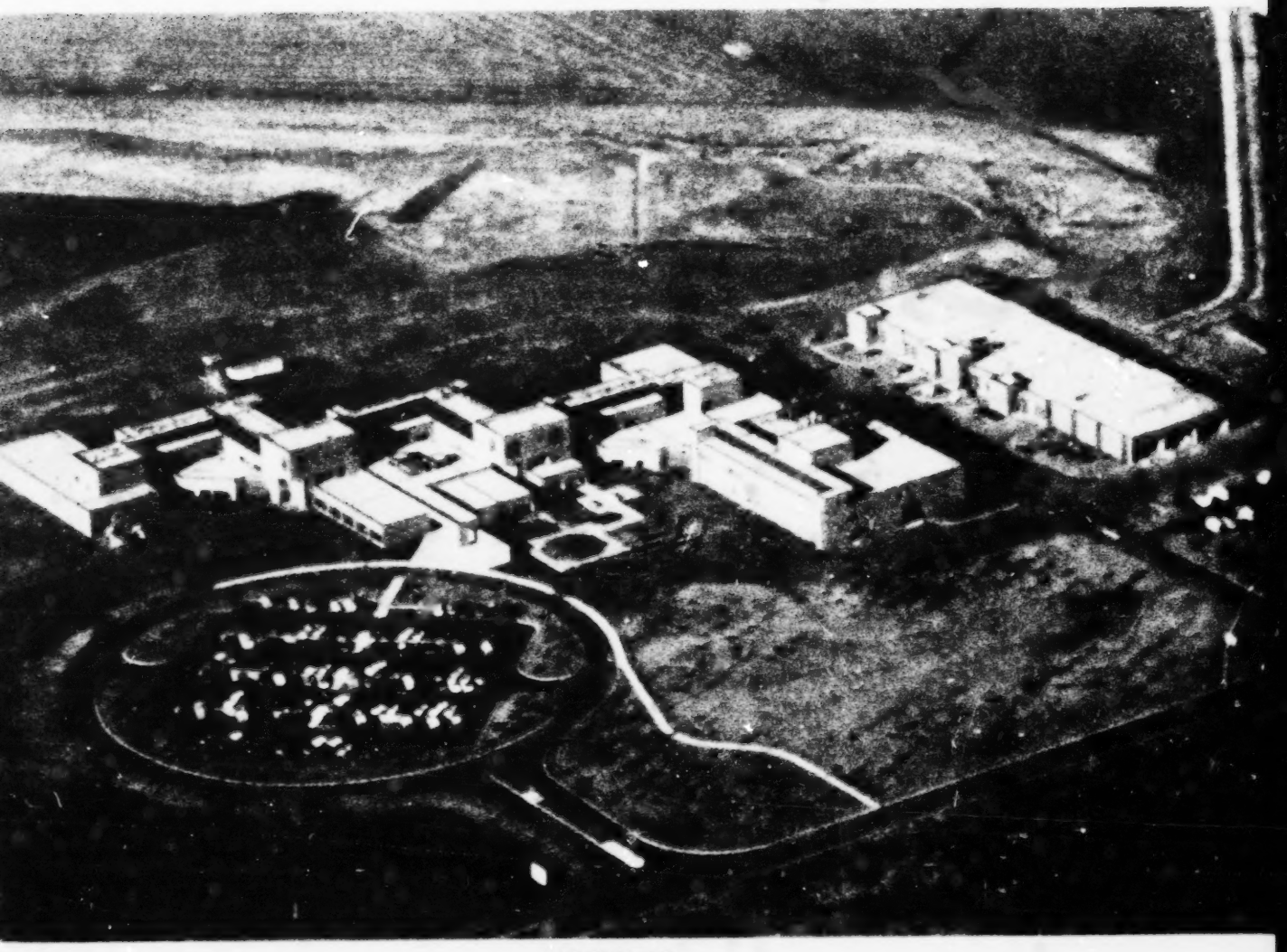
SURPLUS

Alberta Environmental Centre

Alberta

ALBERTA ENVIRONMENTAL CENTRE
ANNUAL REVIEW
1981-1982

ALBERTA ENVIRONMENTAL CENTRE
VEGREVILLE, ALBERTA



AECV83-AR
ISSN 0715-6634
January 1983

This Report May Be Cited As:
Alberta Environmental Centre. Annual Review 1981-82.
Vegreville, Alberta. January, 1983.
52 p. AECV83-AR

Contents

Introduction 7

Analytical, Diagnostic, Extension and Technical Services 11

Pest Management Research and Development 17

Waste Management Research and Development 21

Water/Wastewater Research and Development 23

Living Natural Resources 27

Environmental Toxicology 31

Land Resources Management Research and Development 33

Administration Support 35

Alberta Environmental Centre Programs 39

Staff Committee Memberships 41

Staff Roster 42

Journal Publications 44

Other Publications 45

Board of Directors 47

Technical Advisory Committee 47

INTRODUCTION

The Alberta Environmental Centre (AEC) is a centralized facility providing analytical and laboratory services, applied research and development to provincial government departments and agencies.

The Centre, officially opened in June, 1981, implemented a broad range of programs and projects in the fiscal year ended March 31, 1982.

- History and Mandate
- Facilities and Site
- Program and Project Development
- Interdisciplinary Research
- Program Organization

History and Mandate

The Alberta Environmental Centre was officially opened on June 12, 1981, by the Hon. Peter Lougheed and other provincial dignitaries. The opening ceremonies marked the culmination of eight years of planning and development for Canada's first interdepartmental, interdisciplinary environmental research and service agency. However, even before the official opening, the Centre had started meeting its mandate to provide a central facility for the study and solution of environmental problems identified by departments and agencies of the Government of Alberta.

Within that mandate, activities were grouped into three general areas: analytical and diagnostic services, applied research, and technical development. Activities in those areas included: conducting physical, chemical and biological testing needed for government environmental programs; providing central facilities for research on the effects and control of environmental disturbances; and generating scientific and technical information needed for improved environmental management.

More specifically, AEC work included such diverse activities as testing drinking water, training agriculture workers in plant disease, insect and weed identification and control, and conducting toxicology research, an area in which Canada, particularly western Canada, has inadequate resources.

The concept of an interdepartmental facility to study and solve environmental problems was approved by the Alberta Government in 1973. Design of the main laboratory building in Vegreville, 100 km east of Edmonton, was completed and the building tendered in August, 1977. Senior and support staff were hired beginning in 1977 and continued detailed program development. That staff moved to temporary quarters in Vegreville in 1979. Completion of the main laboratory building contract, on schedule and under budget, was achieved in June, 1980. This was followed by the transfer to Vegreville later that summer of designated staff and equipment from the Departments of Agriculture and Environment in Edmonton.

The 16,700 square-metre main laboratory building is located on a site of approximately 300 hectares, within the western limits of the Town of Vegreville. The main building is organized into five Wings — Common Services, Plant Sciences, Chemistry, Animal Sciences and Environmental Technology. At completion of the main building contract, some 25 per cent of laboratory space was deliberately left in the rough finish state to allow for program development. During the past year, much of that space was finished as new programs were approved and implemented. While programs were operational in the past fiscal year, equipping laboratories continued to be a significant activity, especially in the Environmental Technology Wing. Because of the technical support nature of its work, this Wing was developed later than the other Wings.

Other facilities, including a 3,000 square-metre services buildin 100 square-metre interim laboratory waste treatment plant, site manager's house, and four 250,000 gallon waste storage lagoons, brought the total capital investment to approximately $28 million.

Most of the site is suitable for crop production. Portions of the site were used extensively for field plots related to the work AEC carries out as the provincial agency responsible for gathering Alberta-based data on proposed pesticides for Agriculture Canada's new product registration procedures. Other site work included landscaping and grounds maintenance, reclamation research plots, fencing, roads, shelterbelts and other related activities.

Facilities and Site

All work at the Centre was carried out in response to requests from departments or agencies of the Government of Alberta. Major users or clients were: the Departments of Environment, Agriculture, Energy and Natural Resources, and Workers' Health, Safety and Compensation; the Alberta Research Council; and Health Units throughout the province.

Provision of services to such a variety of government users is achieved through a unique reporting structure. For routine administrative matters such as personnel and budgeting, the Executive Director of AEC reports to the Deputy Minister of Alberta Environment. In policy matters, the Executive Director deals with a Board of Directors, made up of Deputy Ministers or their equivalent from each of the major client departments and agencies.

Requests for AEC to study particular environmental problems normally are directed to the Centre from a Technical Advisory Committee (TAC), a group made up of senior technical staff from client departments. These requests are reviewed at AEC, and a proposal returned to the Technical Advisory Committee for further comments and suggestions. Finally the TAC sends these proposals and their comments to the Board of Directors, which recommends to the Minister of Environment that the proposals be approved, altered or rejected.

Before approval Centre programs are examined in each client department for their relevance, timeliness and completeness. As well, program proposals are evaluated according to other general criteria such as: do they address environmental questions of major concern to Alberta; will they answer specific requests of participating departments and agencies; are they issues of persistent and widespread public concern; are they technically feasible and original; do they have intermediate- or long-term relevance; is there a good chance of producing practical results with a favorable cost benefit ratio? Another consideration is how the proposals fit into the Centre's interdisciplinary method of operation.

Program and Project Development

Interdisciplinary Research

The interdisciplinary research approach, adopted at AEC because of the complexity and breadth of environmental problems, continued to be refined and developed. Steps were taken to implement and test interdisciplinary procedures to enhance this relatively untried method of environmental research management. The objective was to develop a formal system of tackling environmental concerns by integrating the expertise of various specialists so that results obtained will be superior to those obtained by an individual.

One step taken to develop interdisciplinary research was the establishment of Project Teams to work on particular questions. In one case, an Ad Hoc Committee was first directed to develop a list of the 10 most environmentally significant biocides in Alberta, a task which was completed after a review of more than 500 biocides. This was followed by establishment of an interdisciplinary Project Planning Team which was directed to select and rank three priority biocides from the list of 10, and propose a detailed program plan for further investigation. This process was supplemented with in-depth seminars where Centre staff deliberated on the approach. Finally, a Project Implementation Team, under a Project Leader, was assigned the task of carrying out the research.

Among the disciplines which may be represented on the Project Teams are chemistry, toxicology, pathology, veterinary medicine, biology, chemical engineering, biochemistry, entomology, library science, plant pathology, and many more.

Program Organization

Though the Centre physically and organizationally has five Wings — Plant Sciences, Chemistry, Animal Sciences, Environmental Technology, and Common Services — the interdisciplinary research process dictates a matrix or cross-Wing format for co-operative studies. Accordingly, the activities of AEC were divided into eight Program Areas, each containing input from most if not all Wings.

The Program Areas are aimed at grouping of environmental problems which have some common characteristics. Each Program Area is further divided into Programs (and these into projects, sub-projects and so on) directed at answering particular environmental questions.

The following are Program Areas as of March 31, 1982.

1. Analytical, Diagnostic, Extension and Technical Services
2. Water/Wastewater Management Research and Development
3. Pest Management Research and Development
4. Environmental Toxicology
5. Living Natural Resources
6. Waste Management Research and Development
7. Land Resources Management Research and Development
8. Administration Support

Analytical, Diagnostic, Extension and Technical Services

This Program Area involved a broad range of activities associated with the detection, description and understanding of environmentally important living and non-living agents and substances. It also provided a range of specialist services to users within and outside the Centre.

- Microbiological Identification Services
- Pest Management, Diagnostic and Extension Services
- Precipitation Studies
- Analytical Services (water)
- Analytical Services (air)
- Lake Nutrients
- Trace Organics Analysis and Methods Development
- Geochronology Services
- Site Environmental Services
- Aquatic Biology Services
- Related Programs

Microbiological Identification Services

With the establishment of a 16-test rapid identification series, some 426 microbiological sample identifications were carried out. This service was provided in support of several Centre projects including plant disease diagnosis, fish maintenance, population ecology of bears, and biological weed control. Except for medically important bacteria, the service is unique to Alberta.

Pest Management, Diagnostic and Extension Services

Work in this program fulfilled a Centre commitment to provide pest diagnostic, advisory and extension services to agricultural producers and provincial government field staff in central and north-central Alberta. Diagnostic and advisory services for plant diseases, weeds and insects were provided. Staff also offered a diagnostic service to farmers with suspected chemical damage to their crops. Professional backup in these fields was provided to Alberta Agriculture's Regional Crops Laboratories in Brooks, Olds and Fairview, as well as to other provincial agencies.

Over 2,000 plant and insect specimens were submitted to Centre laboratories for identification. These included 1,027 plant specimens sent in by farmers, commercial greenhouse growers and amateur gardeners for disease identification. Some 315 weed specimens were identified and 592 insect specimens were diagnosed for provincial agencies such as Health Units, and the Regional Crops Laboratories. As well, 730 plant specimens were analysed for suspected damage by chemicals. Thirteen years of insect diagnosis records were compiled for computer storage to provide historical information on distribution and significance of insects in Alberta.

Several surveys were carried out on plant diseases, weeds, and crop and livestock insects. Staff participated in surveys on verticillium wilt of alfalfa, blackleg of canola and bacterial ring rot of potatoes. Insect carriers of potato diseases were surveyed in elite seed potato plots for the Alberta Seed Potato Improvement Program. A survey of picloram (TORDON) residues in roadside sloughs resulting from roadside application of picloram throughout the province of Alberta was conducted in cooperation with the Weed Control Branch, Alberta Agriculture and the Pesticide Chemicals Branch, Alberta Environment.

Related activities included collection and preparation of weed species for the herbarium, establishment of 55 reference species in a weed garden, and performance of 13 experimental studies on the detection of herbicide residues in soil.

Precipitation Studies

Developing methods of detecting the degree of acid deposition in Alberta was a major activity of this program. Work centred on development of analytical methods for the determination of acidity of both wet (rain and snow) and dry (dustfall) precipitation. Procedures were developed for testing sulphates, nitrates, phosphates, sodium, calcium and other constituents of precipitation using ion chromatography. These methods were published in a 'methods manual'.

A second major objective of the program was to conduct surveys to determine the composition of precipitation samples collected from various parts of the province. Staff co-operated with Alberta Environment's Research Management Division in a joint study in the Athabasca Oil Sands area, analyzing more than 500 precipitation samples for some 6,000 constituents and characteristics.

Analytical Services (Water)

The Centre's largest and most important direct contribution to human health in Alberta was made through the testing of water to determine its suitability for human consumption. Through the provincial Health Units, the Centre tested essentially all water supplies used for drinking by the public. The Centre received 10,174 individual drinking water samples and tested them for almost 200,000 individual constituents. Each sample was routinely tested for 17 constituents and characteristics. Major users of the service were as follows:

Health Unit	Drinking Water Samples Submitted
Red Deer	794
Sturgeon	719
Alberta East Central	668
Leduc/Strathcona	641
Mount View	641
Vegreville	634

In addition to drinking water, approximately 700 samples of municipal and industrial effluent requiring a total of 20,000 tests were analyzed for Alberta Environment's Pollution Control Division. These environmental samples were tested in support of provincial licencing and regulation programs. Another 300 samples requiring 3,000 tests were analyzed for other agencies.

Analytical Services (Air)

Activities in this program provided chemical analysis services to Alberta Environment as required for the enforcement of the Clean Air Act and for issuing operating licences for industry. Tests for sulphur dioxide and hydrogen sulphide were performed on samples collected by the monthly monitoring of all oil and sour gas plants in the province. In addition, industrial stacks were routinely monitored. Ambient air in Alberta's main urban centres, near major industrial areas and in residential areas were monitored for particulates, benzo(a)pyrene, sulphate, nitrate, lead and other toxic metals.

During 1981-82, 4,262 samples were analyzed for 15,589 substances and chemical characteristics. This included air samples regularly collected from approximately 300 air monitoring stations throughout Alberta.

Monitoring for trace amounts of vinyl chloride in ambient air was carried out in the Fort Saskatchewan area. An average of 18 samples per week were analyzed from the time the work was initiated under ministerial order. As well, sampling and analytical procedures for vinyl chloride were updated and adopted.

Lake Nutrients

Some 900 water samples requiring 20,000 analytical tests were processed in support of an Alberta Environment program of evaluating the environmental status of selected Alberta lakes. Analyses were aimed at providing information on chemical constituents of the lakes and loadings of constituents in streams and rivers running into and out of the lakes. Extensive tests on Lake Wabamun and Cold Lake were carried out.

In support of the lake nutrients study, the capacity to analyze lake and river sediments for various phosphorus fractions was also established.

Trace Organics Analysis and Methods Development

Analytical services for the detection of traces of organic compounds were provided to clients, including Health Units and Alberta Environment, who required testing of surface water, drinking water and industrial effluents. Typical analyses included tests on haloforms in municipal drinking water, vinyl chloride in water, fecal sterols, PCB's and individual taste and odor problems. Approximately 300 samples were analyzed for trace organic compounds.

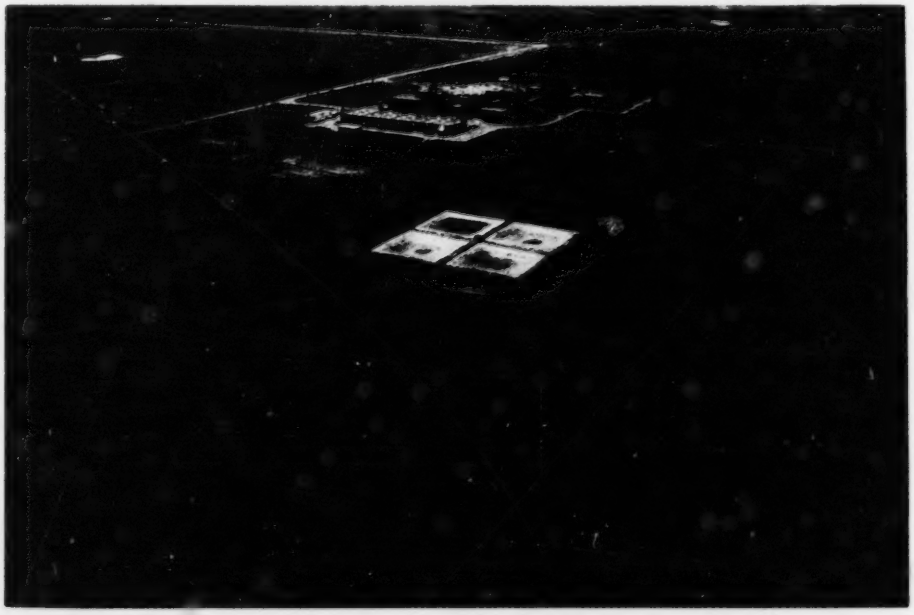
A second area of activity had the objective of increasing the number of trace organic compounds which can be routinely detected and measured in water, sediments and biological material.

Geochronology Services

Work progressed toward implementing routine radiocarbon and tritium analysis procedures capable of estimating the age of materials as old as 40,000 years, thereby providing a time frame for the rates of change of many natural processes. The radiocarbon method measures the natural rate of decay of one form of carbon, while the steady depletion of tritium is used in the other method. The heart of the system established is a set of high sensitivity scintillation counters linked via a control computer with a multi-sample unit. Discussions continued on providing client services which may include applications in groundwater studies, geology, archaeology and other fields.

Site Environmental Services

A program of Site Environmental Services was implemented, primarily to minimize the Centre's environmental impacts on the Vegreville area. Much of the activity centred on operation and further development of a laboratory wastewater treatment system. Long-term storage lagoons to contain difficult-to-treat chemical wastes were commissioned. Wastewater discharged from the Centre was sampled and analyzed before final disposal.



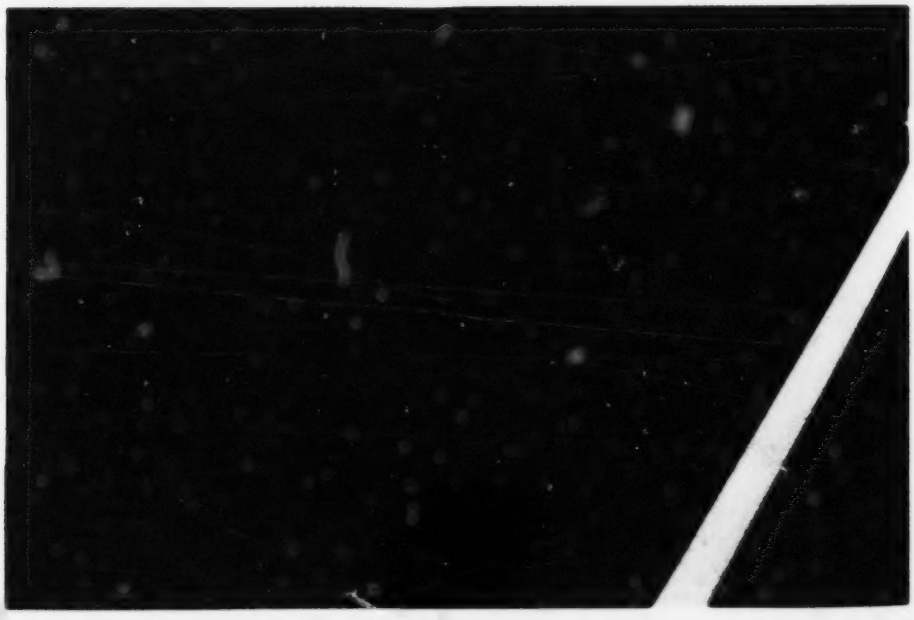
Aquatic Biology Services

Progress was achieved in the development of a 400,000 litres per day internal water treatment system to provide high-quality water for Centre programs, particularly the maintenance of fish and aquatic invertebrates. The design, unique among Canadian research laboratories, includes a secondary treatment plant capable of upgrading and recycling 90 per cent of the water in fish holding areas.

Activity in this area also included the hatching of rainbow trout to provide test organisms for bioassays. Another activity was provision of technical advice to the public, industry and other government agencies on subjects such as chemical residues in fish tissues and the impact of algal blooms.

Related Programs

Several related programs provided special services to users inside and outside the Centre. For example, 60 remote bear trap monitors, and a lighting system which imitates sunrise and sunset in fish holding areas, were developed. An identification service for suspected vertebrate pests was offered, as was a response capability for short-term toxicology problems. Other services provided included; animal feed analysis for internal programs, and provision of resource data banks of toxicology information.



Pest Management Research and Development

Work in this Program Area is aimed at reducing pest interference with man's activities through an integration of cultural, chemical and biological control methods for maximum economic benefit at minimum environmental risk. Pests receiving priority were plant diseases, weeds, and insects of crops and livestock. Research and development maintained a strong agricultural orientation and also included development and use of techniques for the detection and analysis of pesticides in the environment.

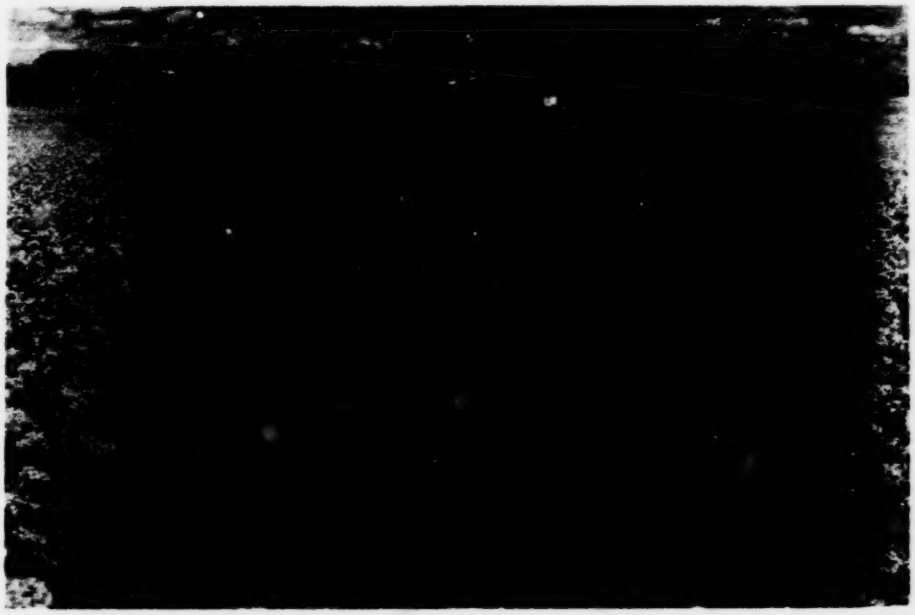
- Plant Pathology Research and Development
- Insect Pest Management Research and Development
- Weed Management Research and Development
- Pesticide Analysis and Methods Development

Plant Pathology Research and Development

Research on diseases of forages, cereals and oilseed crops was aimed at generating control and prevention information. Diseases of canola received the most attention during the year.

Field-scale demonstrations of control of white mold on canola were conducted in co-operation with Alberta Agriculture. Aerial application of benomyl fungicide gave effective control of the disease in the trials.

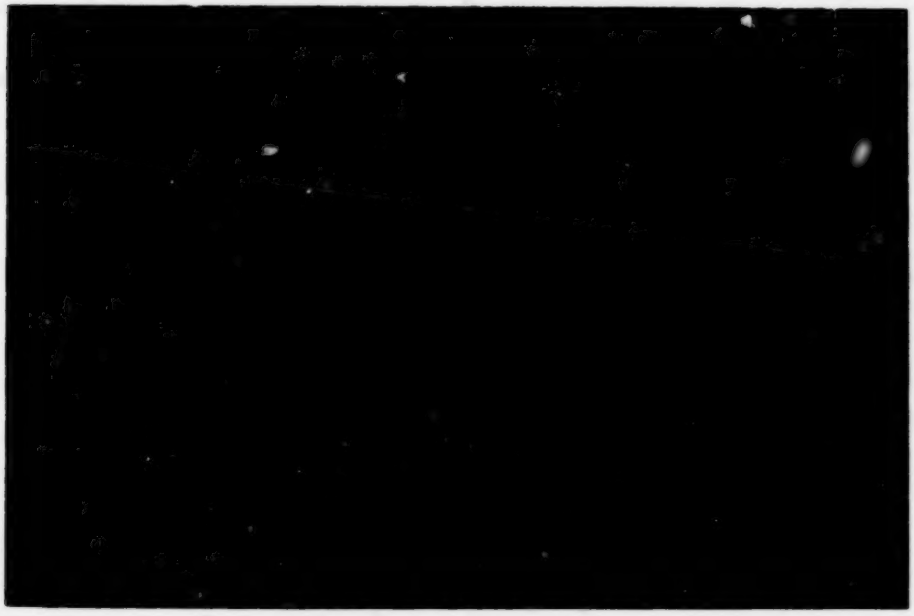
Work also progressed toward an understanding of the occurrence and problems posed by clubroot of crucifers. For the first time, the disease was found in Alberta infecting cabbages in gardens in Stettler and Edmonton. There is concern that clubroot could pose a serious threat to the province's canola crop. Work in 1981 confirmed persistence of the disease, mainly in central Alberta locations.



Insect pest management research included work on insects of ornamental and horticultural crops, field crops and livestock. In the ornamental crops area, a survey for the insect carriers of Dutch elm disease was again carried out. For the third consecutive year no vectors were found, leaving Alberta one of only two regions in North America free of the disease. A biological control program, using insect predators and parasites, achieved excellent control of important greenhouse insect pests at Muttart Conservatory in Edmonton; the need for regular chemical control was eliminated. In cooperation with other researchers work was started to develop chemical control of chrysanthemum leaf miners, a greenhouse pest of increasing severity in Alberta. Work on chemical control of root maggots in rutabagas was also initiated to develop information on control methods for clients.

Research on field crop insect pests included evaluation of products for control of flea beetles and Bertha armyworms on canola crops. As well, studies on the use of pheromone-baited traps for monitoring Bertha armyworm populations across Alberta provided early warning of outbreaks. A special study was started to determine why Bertha armyworms in the Peace River region were not attracted to pheromone traps. A sampling method was developed for use by farmers to accurately assess larval density as a basis for making sound control decisions. A pilot survey for root maggots in Alberta canola crops was completed at the request of Alberta Agriculture.

A study of the impact of horn flies on range cattle productivity showed significant economic gains through horn fly control. Other livestock insect pest management work included a continued evaluation of new horn fly control products and techniques. A survey of northern grazing reserves for the presence and abundance of horn flies was completed, as was an evaluation of new methods and products for house fly control. In cooperation with Alberta Agriculture and a packing plant, a survey of the incidence of swine mange in butcher hogs was carried out.



Insect Pest Management Research and Development

Weed Management Research and Development

Herbicide and weed control research provided information on the efficacy and crop tolerance of experimental herbicides, providing data for the product registration process. Seventeen field trials were conducted to evaluate herbicides and the influence of adjuvants on herbicide effectiveness. Further work centred on control of volunteer crops, winter wheat tolerance to herbicide residues, and influence of residues of fall-applied Canada thistle herbicides on the succeeding canola crop. In all, 29 field trials were set up to study the influence of carry-over of herbicide residues on succeeding crops.

Studies on the biology and ecology of economically important weeds included six field trials on the biology and control of cleavers, hempnettle, and scentless chamomile. There was additional work on classification and biology of leafy spurge, on laboratory trials of weed seed germination and on weed-crop competition.

Field plots were set up to study establishment and survival of a beetle from Switzerland which may be useful in biological control of leafy spurge in environmentally sensitive areas such as river banks. A shipment of a second beetle species was received from Switzerland for field testing in Alberta. The European station of the Commonwealth Institute for Biological Control in Switzerland was contracted to screen biological agents for control of leafy spurge. Field plots were established near Wainwright to study the survival and establishment of an imported fly for control of perennial sow thistle.

Pesticide Analysis and Methods Development

Analyses of pesticide residues in soil, water and sediments were provided to Health Units and several government departments in support of maintaining water quality standards and ensuring safe and efficient herbicide and insecticide use.

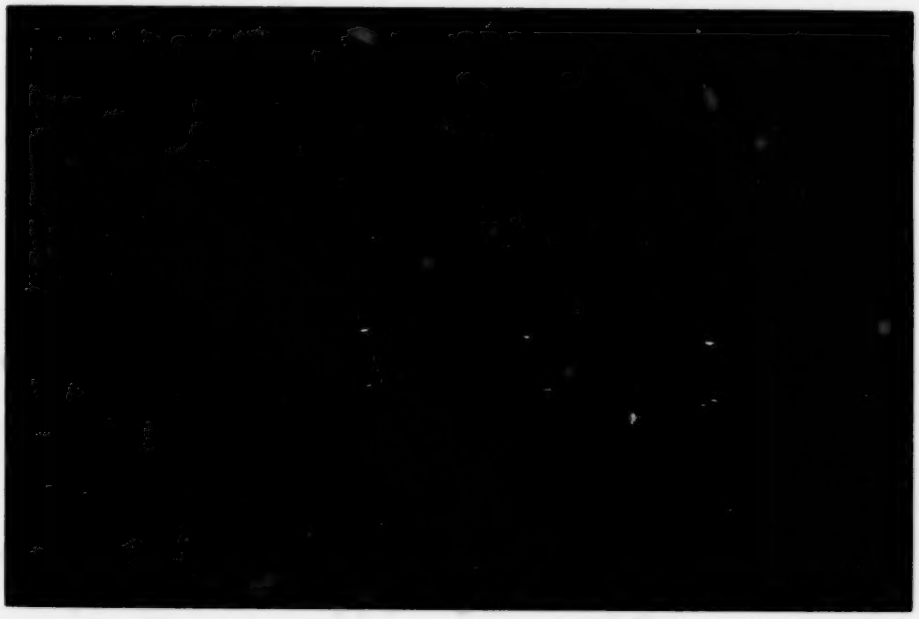
During the past year over 250 pesticide samples were analyzed for a wide variety of pesticides. In addition to providing information needed for routine environmental monitoring, several emergency analyses were performed in support of the province's pollution emergency response program.

To ensure that the Centre can provide this pesticide residue analysis for new and existing pesticides, new laboratory analytical methods were developed. Generally, this involved extracting a sample with a solvent, cleaning up the solvent and analyzing it by instrumental techniques. Analytical methods were developed for diuron, linuron, difenzoquat, paraquat, methoxychlor and lindane.

Waste Management Research and Development

This Program Area evaluates agricultural, industrial and municipal wastes as a resource to minimize cost and environmental impact of disposal. General objectives include evaluation of waste handling and disposal practices, testing and developing novel techniques of handling and disposal, and developing sound data on waste management alternatives.

- Feedlot Wastes and Waste Management
- Toxic Wastes and Microbial Metabolism
- Cellulose Biotechnology



Feedlot Wastes and Waste Management

There is some concern that cattle manure handling and disposal techniques cause nuisance odors and harmful discharges into waterways, along with the probability that farmers are failing to use a valuable resource to its maximum potential. To focus these factors, a workshop was held involving government and university scientists, ranchers, feedlot operators and others, in an examination of concerns about the environmental impact of cattle feedlots. Following evaluation of the workshop, a feedlot waste Project Team was set up to begin planning for selecting sites, establishing a schedule and collecting samples in a study of microbiological aspects of feedlot wastes. As well, a literature search was conducted to prepare a Bibliography of Cattle Feedlot Manure Management.

Toxic Wastes and Microbial Metabolism

An examination of the role of microorganisms in the uptake of toxic heavy metals was initiated. Studies of how microorganisms take up metals may provide information on how bacteria can remove the metals from sewage sludges which are sometimes discharged into land and water environments. About 400 bacterial isolates were obtained from various habitats, 30 were assessed for tolerance to one form of chromium, and two were used for detailed studies of chromium tolerance and uptake.

In related work, two microbial tests (**Spirillum volutans** and Microtox) were introduced for the rapid detection of toxic substances. The Spirillum test relies on reduced movement of a bacterial species when confronted with a toxic substance, while the Microtox assay is based on changes in natural light emission when a luminescent bacterium is challenged with toxicants. Some 50 tests were performed on various toxic materials including copper, zinc, nickel, chromium, phenol and others. These tests may prove useful in a battery of short-term assays for rapid determination of the toxicity of aquatic samples and for routine monitoring of effluents and toxic substances.

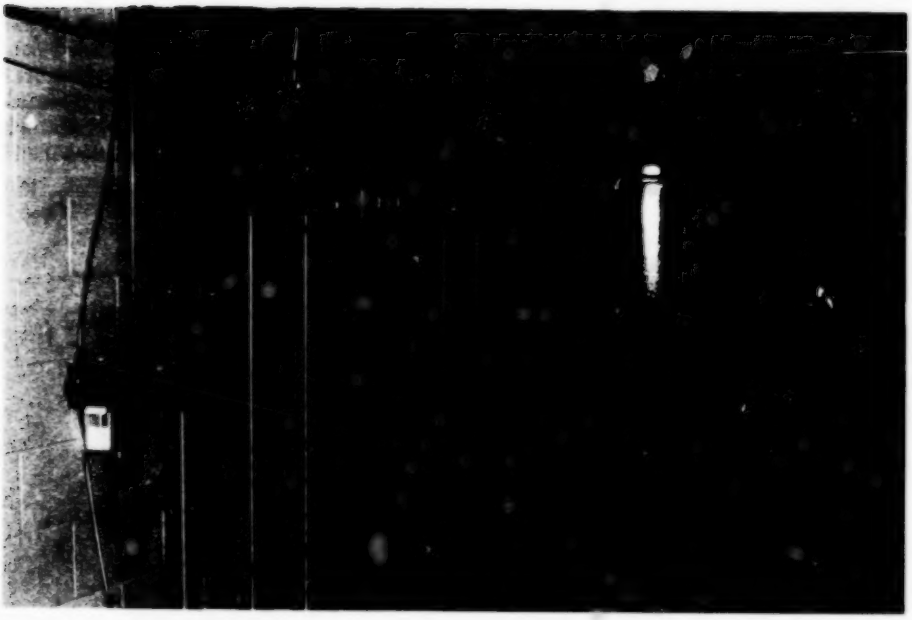
Cellulose Biotechnology

Work on cellulose biotechnology concentrated on organisms which show potential for breaking down wastes such as straw and paper into a form suitable for use as animal feed. Studies were carried out on selected isolates for growth characteristics, optimum cultural conditions and cellulose production. The immediate objectives are to develop plans to select several suitable organisms and produce sufficient feed for animal trials.

Water/Wastewater Research and Development

Research in this Program Area concentrated on problems of supplying water for drinking, recreational, agricultural and industrial uses while minimizing environmental impacts. Major work was conducted on aquatic toxicology and internal water improvement projects.

- Aquatic Toxicology
- Environmental Chemistry of Wastewater
- Water Quality Improvement



Aquatic Toxicology

Four aquatic toxicology projects were carried out to provide a comprehensive description of the effects of industrial, municipal and agricultural wastewater on water life, particularly fish. In one project, rainbow trout were used in acute lethality tests to provide information about the toxicity of industrial effluents for Alberta Environment's monitoring and licencing activities. Approximately 30 such biological tests were conducted in 1981-82.

Another project analyzed some 900 tissues from fish collected in 20 major Alberta rivers and lakes to detect the presence of chlorinated pesticides, herbicides, polychlorinated biphenyls (PCB's), mercury and other substances. Several areas were identified for more detailed sampling of sediments and water to provide additional information on the source and extent of identified contaminants. The project was carried out for the Fish and Wildlife Division, Alberta Energy and Natural Resources. It was designed to determine possible health hazards to humans who eat fish, and to provide background information on chemical levels in fish before further industrialization of Alberta.

Fish were also collected to study effects on their tissues induced by discharges of industrial, municipal and agricultural wastewaters. Analysis showed that fish collected below industrial discharge points exhibited elevated fat levels in their livers, indicating some abnormal metabolic functions. These changes were compared with the presence of organic contaminants in their tissues.

Research evaluating the toxicity of specific chemicals to aquatic life examined how lindane in water distributes among the water, sediments and different forms of aquatic life. Results indicate that sediments take up approximately 90 per cent of the chemical while fish eggs contain 150 times the concentration of the chemical in water. Toxic effects of the chemical to trout eggs and fry were investigated.

Environmental Chemistry of Wastewater

This program was directed at providing a comprehensive description of physical/chemical processes affecting the toxicity of wastewater to aquatic life.

A project on agents of environmental concern was set up to rank chemical and biological agents likely to pose a hazard to aquatic life in Alberta. Literature on the subject was reviewed, published data were analyzed, and a tentative list of agents of concern was prepared. A refined list will be used to develop further aquatic toxicology research efforts and to provide information to client departments for the design of their monitoring programs.

Results of another trial yielded information on the relative toxicity of different portions of an industrial effluent. Effluent from a fertilizer plant was separated into four components and rainbow trout bioassays were used to determine the toxicity of the different components. It was shown that the whole effluent was more toxic than suspended solids and other effluent fractions. Such information may contribute to the development of wastewater purification schemes.

Water Quality Improvement

A reverse osmosis water treatment plant was brought on stream in October to pretreat supply water for Centre laboratory needs. The plant produced up to 6,000 litres of water per day, and provided up to 99 per cent removal of most impurities.

Work started on a 400,000 litres-per-day water treatment system for the aquatic biology laboratories where 90 per cent of the water used will be recycled. Work was carried out on process monitoring, control system design and implementation and mechanical design of the system.

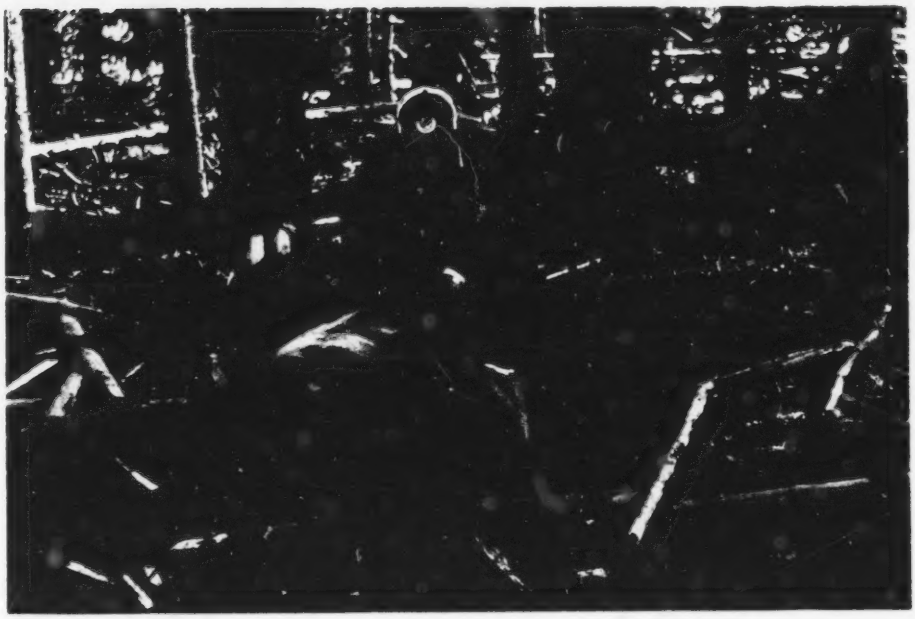
Detailed planning of studies on groundwater treatment and sewage lagoon design parameters was undertaken.

Living Natural Resources

This Program Area includes research on the effects of physical, chemical and biological changes on living resources including grasslands, forests, aquatic species, birds and mammalian wildlife.

Significant research efforts were carried out on a variety of wildlife species, notably grizzly and black bears, moose, coyotes and rodents.

- Environmental Physiology
- Forest Development and Wildlife Resources
- Problem Wildlife



Environmental Physiology

Three environmental physiology projects were conducted to better understand the effects of environmental disruptions on the biology of wildlife species. Work was designed to measure under controlled conditions factors affecting the growth, productivity and health of the animals.

Field work was completed and laboratory work started on a wildlife nutrition project on habitat selection by moose in the Swan Hills. Resulting data will assist wildlife agencies in evaluating and predicting the impact of environmental disruptions on the distribution of moose and their available food resource in the boreal forest. Work also began on developing methods of measuring feed intake by free-ranging ungulates.

In cooperation with staff of the Elk Island National Park, AEC staff began regular examination of moose carcasses to obtain background information on seasonal organ and tissue changes, and on tissue loads of specific chemicals. Up to 60 measurements were taken per animal and 25 tissues and other samples were analyzed to provide data on how environmental disturbances produce changes in animal tissues.

Staff began investigating possible development of a site for wildlife confinement facilities where the effects of specific environmental disruptions can be tested under approximately natural conditions.

Forest Development and Wildlife Resources

A comprehensive research effort continued on important relationships between industrial development and wildlife in the boreal ecosystem. The research is designed to provide information to assist government and industry in the long-range planning and management of resource activities in boreal forest habitats of Alberta. A program of live-trapping, radio-tracking and collection of extensive data on grizzly and black bears was carried out. Sixteen grizzly bears and four black bears were captured, fitted with radio collars and aerially tracked until denning time. Seasonal distribution, habitat use, population status and productivity of bear populations were assessed.

Activities in the problem wildlife area included research on wildlife species of concern to agriculture, their biology, ecology and control, as well as surveys on the extent of depredation and diagnosis of suspected vertebrate pests and pest damage. In a project on pocket gopher control, a wide variety of methods, toxicants, and baits was tested. Further work suggested that pocket gopher abundance tends to increase with grazing intensity on certain grasslands in the foothills of southwestern Alberta. The work also demonstrated that herbicides that reduce the abundance of broad-leaved plants drastically reduce or eliminate pocket gopher populations on grasslands. As well, control of pocket gophers on headlands next to legume fields seems to prevent re-establishment of populations.

Staff also conducted research to identify factors which predispose domestic sheep to coyote predation. The study examined body weight, height, length of wool, colour, breed, age of ewes and lambs, and other factors which might predispose lambs to attack. It is hoped this information will help make more effective use of toxic collars, devices which protect sheep.

Environmental Toxicology

Research into environmental toxicology included studies on the potentially harmful consequences of chemicals or agents of natural or human origin which are introduced into air, land or water systems.

- Effects of Environmental Sulphur
- Inhalation Toxicology
- Toxicology of Biocides
- Related Programs

Effects of Environmental Sulphur

A pilot study of the effects of atmospheric sulphur emissions on livestock was carried out at four sites in west-central Alberta. The pilot study, in cooperation with Alberta Environment and Alberta Agriculture, gathered basic information on sulphur and trace mineral interactions in air, soils, plants and livestock. Work included examination of selected cattle herds, trace element studies in cattle, chemical and physical analyses of plants and soils and measurement of sulphur deposition. Both sulphur and trace mineral levels were found to be low to deficient.

Centre staff assisted in a field study at five central Alberta sites on the effectiveness of injectable copper supplements for cattle raised on low copper soils.

Work in support of the program included establishment of blood enzyme tests as an indirect measure of element concentration in cattle blood. As well, a Workshop on the Effects of Environmental Sulphur was conducted with client departments.

Inhalation Toxicology

Steady progress was recorded in the provision of physical resources needed to study the toxic effects of gases, vapors, particulates and aerosols on animals. The province's capability of undertaking such research was considerably expanded when approval was granted for construction of a toxicology containment laboratory which will permit up to three 90-day toxicity studies to be conducted at once.

An initial set of exposure chambers for laboratory animals was acquired. Work began on baseline studies of airflow and normal physiological parameters in preparation for studies on the effects of hydrogen sulphide and sulphur dioxide gases on animals.

Toxicology of Biocides

Staff produced an internal report on the 35 most used biocides in Alberta as an initial step toward an examination of effects of insecticides, herbicides and other biocides on non-target species. This was followed by a series of internal seminars held to identify those biocides which might have the greatest consequence in Alberta and which have poorly understood long-term effects on the health and reproduction of animal species. In addition to organizing available information on biocides, this approach served as a method of developing and enhancing the Centre's interdisciplinary research management approach. Following development of sensitive bioassays studies began on possible cattle breed differences in susceptibility.

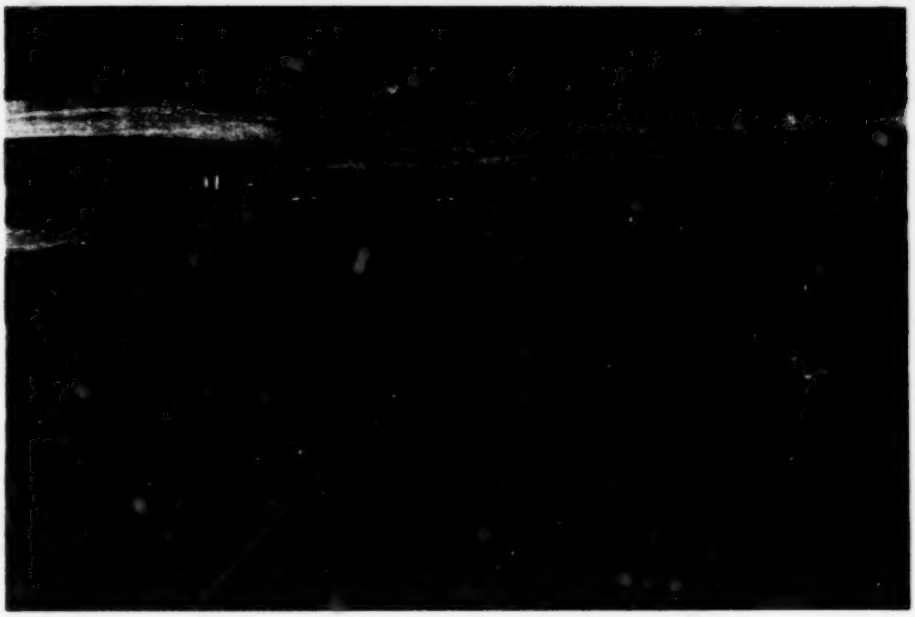
Related Programs

Work either started or reached final planning stages in areas including Genetic Toxicology, Ecological Toxicology, and Chemical Safety Evaluation. Genetic Toxicology work was started using both cell culture systems and live animals to examine the ability of selected environmental chemicals to induce changes in chromosome structure. A number of literature searches were conducted to assess the possibility of a specific chemical causing fatalities in livestock or wildlife, or being potentially toxic to humans.

Land Resources Management Research and Development

While work in this Program Area is still to be formally organized, the Centre became involved in one study consistent with the area's objectives. Those objectives include research on the long-term effects of major uses of Alberta's land base, with emphasis on reclaiming disturbed sites and providing technical solutions to land-use conflicts.

•Reclamation



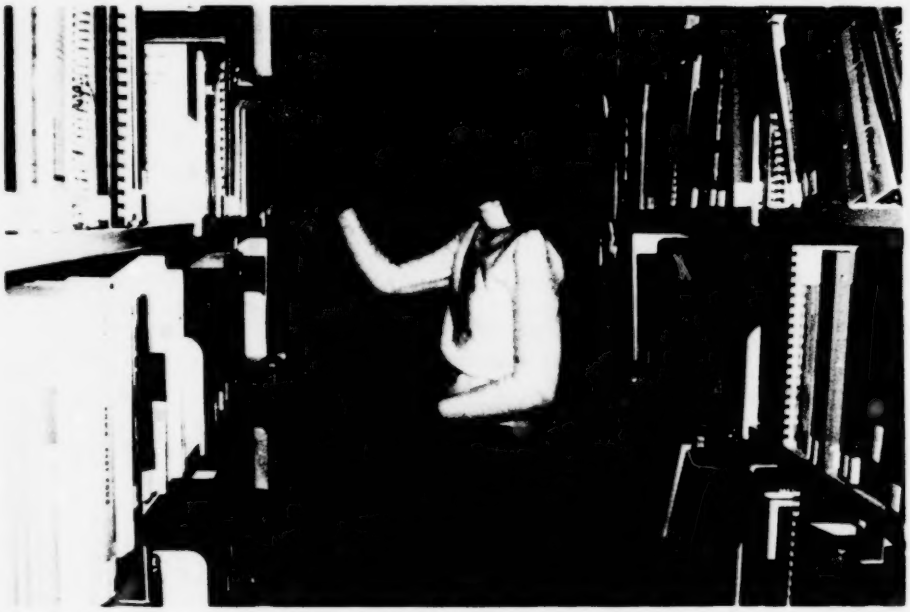
Planning continued toward establishment of a Reclamation Group to be attached to the Plant Sciences Wing. While the Group has yet to be formally organized, it became involved in a study on the response of vegetation to pipeline installation through native range in southern Alberta.

The project, part of a Centre-University of Alberta graduate student program, aims to assess ecosystem responses to changes in soil characteristics and to study subsequent soil-plant interactions. Five pipelines of different ages in one "corridor" (side-by-side rights-of-way) were selected to provide data on plant succession and ecosystem stabilization over time.

Administration Support

Activities in Administration Support included all administrative and technical support operations necessary to the running of the Centre. They encompassed personnel, finance, library services, site services, communications, and the office of the Executive Director, as well as administration and management of each of the Centre's five Wings.

- Administrative Services
- Capital Facilities Development
- Related Programs



Administrative Services

Basic administrative and support services, including budgeting and financial management, recruitment, library facilities and communications continued to be supplied through the Common Services Wing.

Preparation of budgets and monitoring 1981-82 expenditures of $7.4 million were major Program activities. In addition to the standard government (AFIS) budgets, program and project budgets were prepared for consideration by the Centre's Board of Directors.

Staff recruitment was active, with an increase of 38 permanent staff members during the year, bringing the total, including wage and non-permanent personnel, to 173 at March 31, 1982. While several key senior staff members were hired during the year, recruitment in some specialized scientific and technical areas continued to be unsuccessful.

An orientation program for new staff was developed and implemented and several staff training courses were offered in areas such as supervision, training and first aid. Centre staff members were also successfully involved in proposing and implementing changes to the Laboratory Technician classification series.

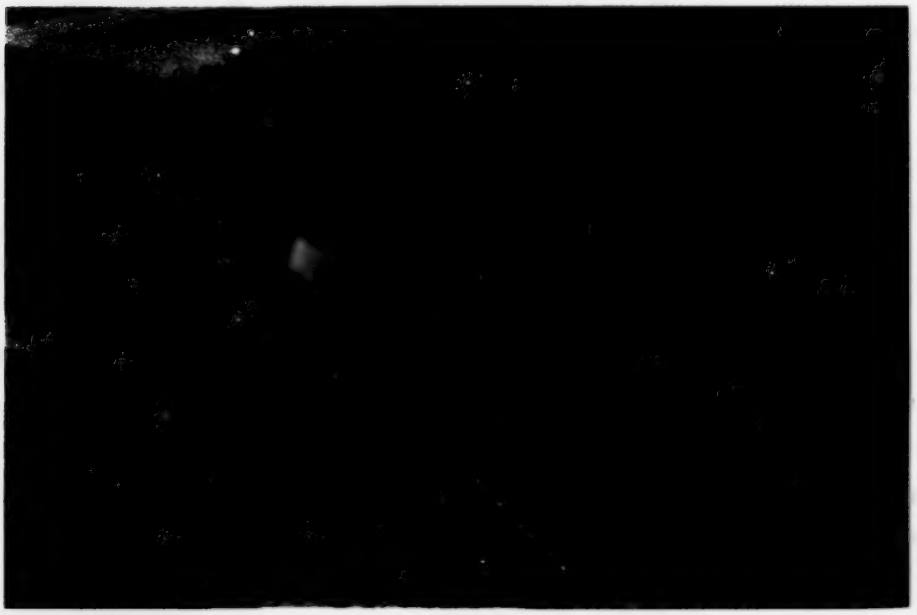
The Centre's Library provided a broad range of information services, providing up-to-date material on advances in the scientific disciplines under study at AEC. The Library collection grew to 7,500 catalogued items including books, journals, microfilm, film and multi-media kits. Reference services offered included computerized database and manual literature searches followed by document delivery. Reprints from outside Alberta were maintained in a reprint file with access through a computerized key-word-out-of-context (KWOK) index. The Library also compiled and published the environmental inventory "Persons Involved in Environmental Research in Alberta".

Communications services provided included production of the Centre's first Annual Review and a monthly staff newsletter.

Other administrative functions included operation of a central filing system, word processing, mail room, central and bulk stores operations and a central printing and duplicating facility.

This Program Area included operation of the Executive Director's office, providing overall direction for all Centre programs. In addition, funds were provided for seminar speakers and for special service arrangements or research contracts, such as a study of biological control of leafy spurge.

Site support services upgraded and maintained the Centre's 300-hectare grounds, including preparation of plots for field trials, planting of shelter-belts and maintenance of vehicles and equipment.



Capital Facilities

Funding was approved and design commenced on a toxicology containment laboratory to allow full implementation of the Centre's Inhalation Toxicology program. This annex to the Animal Sciences Wing of the main building will have separate utilities to provide isolation and secure containment of gases, particulates, vapors and aerosols.

The Centre's 3,000 square metre Services Building was completed, providing space for workshops, a central stores facility, a water treatment plant, chemicals storage and other requirements. Construction of a chemical wastes storage lagoon was completed. Further development of laboratory space in the main building was also carried out.

A Greenhouse Planning Committee delivered recommendations for construction of greenhouses at the Centre.

Related Programs

Each of the Centre's four scientifically-oriented Wings developed management, administration and technical support services to meet its particular needs. Generally, these services covered six areas:

1. administration, including management, planning and clerical services;
2. research support, including general research overhead costs such as experimental design and statistical analysis services;
3. training and development services, including staff and management development and orientation;
4. meetings, conferences, symposia and personal research allowing staff and AEC to maintain a presence in scientific and professional organizations;
5. safety, including establishment of safe operating procedures and training of staff in the use of safety equipment;
6. quality assurance, including procedures to ensure that activities meet recognized statutory and accreditation standards.

ALBERTA ENVIRONMENTAL CENTRE PROGRAMS

NAME	PRINCIPALS AND COOPERATING DEPARTMENTS
1. ANALYTICAL, DIAGNOSTIC, EXTENSION AND TECHNICAL SERVICES	
Routine analytical services (water)	Health Units, Environment, Energy & Natural Resources
Pest management diagnostic and extension services	Agriculture, Environment, Health Units, Energy & Natural Resources
Trace organic analysis and methods development	Environment, Agriculture, Energy & Natural Resources, Health Units, AEC
Microbiological identification services	AEC, Environment
Routine analytical services (air)	Environment, Agriculture, Energy & Natural Resources
Trace organics in ambient air	Agriculture, Energy & Natural Resources
Precipitation studies	Environment, Agriculture, Energy & Natural Resources
Technical support services	AEC
Quality control and data management	AEC, Environment
Wildlife biology services	AEC, Energy & Natural Resources, Agriculture, Environment
Toxicology services	AEC, Agriculture, Environment, Energy & Natural Resources, Workers' Health, Safety & Compensation
Geochronology services	Alberta Research Council, Environment, Agriculture, Archaeological Survey of Alberta
Lake nutrients	Environment
Aquatic biology services	AEC, Environment, Agriculture, Energy & Natural Resources
Pathology services	AEC
Nutrition services	AEC
Experimental animal services	AEC
Site environmental services	AEC
Instrumentation services	AEC
2. WATER/WASTEWATER MANAGEMENT RESEARCH AND DEVELOPMENT	
Aquatic toxicology	Energy & Natural Resources
Environmental chemistry of wastewater	Energy & Natural Resources
Water quality improvement	AEC, Environment
3. PEST MANAGEMENT RESEARCH AND DEVELOPMENT	
Plant pathology research and development	Agriculture
Insect pest management research and development	Agriculture, Energy & Natural Resources, Environment
Weed management research and development	Agriculture, Environment
Pesticide analysis and methods development	Environment, Agriculture, Energy & Natural Resources, AEC, Health Units
4. ENVIRONMENTAL TOXICOLOGY	
Toxicology of biocides	Agriculture, Workers' Health, Safety & Compensation, Environment, Energy & Natural Resources

ALBERTA ENVIRONMENTAL CENTRE PROGRAMS

NAME	PRINCIPALS AND COOPERATING DEPARTMENTS
Genetic toxicology	Environment, Agriculture, Workers' Health, Safety & Compensation, Energy & Natural Resources
Inhalation toxicology	Workers' Health, Safety & Compensation, Agriculture, Environment
Effects of environmental sulphur	Agriculture, Environment
Chemical safety evaluation	Agriculture, Environment, Energy & Natural Resources, Workers' Health, Safety & Compensation
Toxicology of petrochemicals and fossil fuels	Agriculture, Environment
5. LIVING NATURAL RESOURCES	
Aquatic habitat studies	Energy & Natural Resources
Problem wildlife	Agriculture
Environmental physiology	Energy & Natural Resources, Agriculture
Forest development and wildlife resources	Energy & Natural Resources, Environment
6. WASTE MANAGEMENT RESEARCH AND DEVELOPMENT	
Feedlot wastes	Environment, Agriculture, Alberta Research Council
Toxic wastes and microbial metabolism	Environment, AEC
Cellulose biotechnology	Agriculture, Alberta Research Council, AEC
Solid waste management	Environment
7. LAND RESOURCES MANAGEMENT RESEARCH AND DEVELOPMENT	
Reclamation	Energy & Natural Resources, Environment, Agriculture
8. ADMINISTRATION AND TECHNICAL SUPPORT	
Administrative services	AEC
Technical services — Common Services	AEC
Administration — Plant Sciences	AEC
Administration — Chemistry	AEC
Administration — Animal Sciences	AEC
Administration — Environmental Technology	AEC
Administration — Common Services	AEC
Capital facility development	AEC
Research and development studies	AEC

AEC STAFF COMMITTEE MEMBERSHIPS

Alberta Agriculture Cereals and Oilseeds Advisory Committee
Alberta Agriculture Warble Control Committee
Alberta Agriculture Weed Advisory Committee
Alberta Agrometeorology Advisory Committee
Alberta Environment Committee on Acid Deposition
Alberta Environment Finance and Administration Committee
Alberta Environment Information Management Committee
Alberta Environment Reclamation Research Coordinating Committee
Alberta Environment War Emergency Measures Committee
Alberta Environment Executive Committee
Alberta Forage Advisory Committee
Alberta Horticultural Advisory Committee
Alberta Interdepartmental Committee on Pesticides
Alberta Pest Control Advisory Committee
Alberta Society of Professional Biologists, Executive Committee
Alberta Veterinary Medical Association, Council
American Society for Testing and Materials, Microorganisms of Health and Sanitary Significance Section
Canadian College of Microbiologists, Examining Board
Canadian Society of Laboratory Technologists, Examination Panel
Canadian Veterinary Medical Association, National Examining Board
Dutch Elm Disease Advisory Committee
Energy Resources Conservation Board
Expert Committee on Grain Diseases
Expert Committee on Weeds (Western Section)
Federal-Provincial Long-Range Transport of Acid Pollutants, Health Effects Sub-Group
Intergovernmental Aquatic Toxicity Workshop Committee
Journal of Environmental Science and Health: Part B, Pesticides, Food Contaminants and Agricultural Wastes, Editorial Board
Lakeland College Crops Advisory Committee
NAIT Biological Sciences Program Advisory Committee
National Research Council of Canada Associate Committee on Scientific Criteria for Environmental Quality: Subcommittee on Pesticides and Industrial Organic Chemicals
National Sciences and Engineering Research Council of Canada, Reviewer for Strategic Grant Applications
Society of Toxicology of Canada, Education Committee
Society of Toxicology of Canada, Nomination Committee
University of Alberta Horticultural Program Advisory Committee
University of Guelph Student Supervisory Committee
Western Committee on Crop Pests
Western Committee on Livestock Pests
Western Committee on Plant Disease Control
Western Committee on Problem Wildlife
Western Forum of the Expert Committee on Pesticide Use in Agriculture
Wildlife Society Certification Review Board

STAFF ROSTER
(March 31, 1982)

EXECUTIVE DIRECTOR:
R. Sherman Weaver, Ph.D. (McGill)

PLANT SCIENCES WING
HEAD: Bart Bolwyn, Ph.D. (Oregon State)

PROFESSIONAL STAFF:
Chin Bae Chu, M.Sc. (Alberta)
Prem Kharbanda, Ph.D. (Illinois)
Helen Liu, Ph.D. (Guelph)
Hugh Philip, M.Sc. (Alberta)
Fayaz Qureshi, Ph.D. (London)
Paul Sharma, Ph.D. (Alberta)
Marilyn Steiner, B.Sc. (Bath)
Gerald Wheeler, M.Sc. (Alberta)

TECHNICAL STAFF:
Debbie Botten; Harold Feddema; Marion Herbut; Ann Naeth-Melenka, B.Sc. (Alberta); Laureen Soluk, B.Sc. (Alberta); Rita Stevens; Richard Strel; Richard Thuynsma

CLERICAL STAFF:
Karolyn Calder; Rose Mahadeo; Joan Romaniuk; Lorraine Yakemchuk

CHEMISTRY WING
HEAD: John Hardy, Ph.D. (Alberta)

PROFESSIONAL STAFF:
Ijaz Ahmad, Ph.D. (Waterloo)
Henry Bertram, B.Sc. (Alberta)
Roy Clough, B.Sc. (Calgary)
Richard Coleman, Ph.D. (Alberta)
Nirmal Das, Ph.D. (Ottawa)
Fred Dieken, Ph.D. (Victoria)
Rae Keashly, B.Sc. (Calgary)
Yogesh Kumar, Ph.D. (New Brunswick)
Ansar Qureshi, Ph.D. (New Brunswick)

TECHNICAL STAFF:
Norman Arbon; Warren Bilida, B.Sc. (Windsor); Dave Chalupa; Orest Chayka, B.Sc. (Saskatchewan); Penny Chong, B.Sc. (Toronto); Bruce Christensen; John Dach; Lawrence Geleta; Lydia Goatcher, Ph.D. (Maryland); Don Goebel; Cindy Horon; Alan Hrynyk; Melanie Jolicoeur; Barbara Kovacevich; Debbie Laderoute; Debra Langier; Vive Mahadeo; Gerald Mazuryk; Heather Murray; Randy Norton, B.Sc. (McGill); Sharon Novakowski; John Paran, B.Sc. (Alberta); Grant Prill; Ruth Prill; Brian Serink; Shyama Sharma, B.A. (Delhi); Diane Smathers; Diana Spasiuk; Ernest Theophilus, B.Sc. (Punjab); Marie Twine; Larry Uchman; Alessandro Urso; Adolph Wittmeier

CLERICAL STAFF:
Kay McCaffrey; Holly Palley; Dale Runzer; Susan Stecyk

ANIMAL SCIENCES WING
HEAD: Leonard E. Lillie, Ph.D. (Purdue)

PROFESSIONAL STAFF:
Morley Barrett, Ph.D. (Alberta)
Antoinette Chovelon, M.Sc. (Alberta)
Michael Dorrance, Ph.D. (Wisconsin)
William Goatcher, Ph.D. (Oregon State)
Alexander Hawley, Ph.D. (Saskatchewan)
Yumiko Hoyano, Ph.D. (Alberta)
William Lake, B.Sc. (Manitoba)
James Moore, Ph.D. (Bath)
Keith Morgan, Ph.D. (McGill)
John Nagy, B.Sc. (Lethbridge)
Michael Prior, Ph.D. (Saskatchewan)
Subramanian Ramamoorthy, Ph.D. (Madras)
Laurence Roy, M.Sc. (Idaho)
Rajinder Sharma, Ph.D. (Illinois)

TECHNICAL STAFF:
Pamela Cole; Lee George; Norma Graham, B.Sc. (Winnipeg); Clare Gulayets; Doris Haudeck; Lynn Klassen; Alfred Kolenosky; Marlene Lefebvre; David Lovejoy; John Martin, B.Sc. (Guelph); Elizabeth McGuiness; Toni McMillen; Joe McMullen; Jack Nolan; Sita Ramamoorthy, M.A. (Madras); Kevin Smiley; Katherine Watson, B.Sc. (Alberta); Neil Webb; Kathleen Wilson, B.Sc. (Carleton); Shirley Yong, M.Sc. (Alberta)

CLERICAL STAFF:
Barbara Anderson; Michaelene Eask; Arhlene Hrynyk; Charlene Melnyk; Patricia O'Shea

ENVIRONMENTAL TECHNOLOGY WING
HEAD: Malcolm A. Wilson, Ph.D. (London)

PROFESSIONAL STAFF:
L. David Arnold, Ph.D. (Arizona)
Atif Boni, M.Sc. (Delft)
Stephen Davies, Ph.D. (Western Ontario)
Albert Liem, Ph.D. (McMaster)
Peter Singer, Ph.D. (Alberta)
Albert van Roodselaar, Ph.D. (Alberta)

TECHNICAL STAFF:
Tom Charity; Heather Hill; Leon Koverny; Charles Montandon; Rick Nutbrown; Rina Varma, Ph.D. (Alberta)

CLERICAL STAFF:
Linda Hoover; Linda Sorochak; Colleen Yaskiw

COMMON SERVICES WING

HEAD: Stan Selinger, B.Comm. (Calgary)

PROFESSIONAL STAFF:

Baynish Bassett, B.A. (Saskatchewan)
Jim Bradley, B.Sc. (Alberta)
Brenda Hawley, B.A. (Queens)
Harriet Judge, M.L.S. (Alberta)
Herb King, B.Comm. (Alberta)
Diana Lee, M.L.S. (Alberta)

TECHNICAL STAFF:

Audrey Lyons; Janice Osrunn, B.Sc. (Maine); Pauline Romanchuk

CLERICAL STAFF:

Wendy Axley; Diane Buchkowski; Barbara Burchill; Pauline Degenstein; Ramona Ergezinger; Pat Ferleyko; Kenneth Friebe; Mary Ann Fried; Reeva Gordash; Wanda Granger; Earl Hawryluk; Loretta Hodge; Gloria Horon; Sonia Hunka; Kathy Ilkiw; Sophie Korpan; Marianne Kostyniuk; John McLeod; Catherine Olineck; Darlene Peterson; Gael Ronaghan; Leta Sokoluk; Melanie Thibault; Madeleine Thomlinson; Dixie Warren; Annette Yaremchuk; Sylvia Yaremchuk; Pat Zimmel; Lauren Zukiwski

SITE SUPPORT SERVICES

HEAD: Arne Aasen, M.Sc. (Alberta)

PROFESSIONAL STAFF:

Gary Lofthaug, B.Sc. (Alberta)

TECHNICAL STAFF:

Peter Conway; Bill Holyk; Bill Lemiski; Joe Nowak; Len Nowak; Lois Robinson; Harvey Schultz

ALBERTA GOVERNMENT SERVICES

Peter Clement; Bill Czar; June Doolittle; Jean Dussome; Don Ferguson; Paul Godziuk; Don Henderson; Don Kenyon; Berna Kirechuk; John Kirechuk; Henry Kostiniuk; Keith Kreamer; Lucille Nowak; Marshal Palichuk; Gordon Rennie; Harry Sawchuk; Horst Schumig; Lynn Thimer; Helen Toma; Brad Tymchuk; Walter Tymchuk; Ken Yakimovich; Jim Zuk

JOURNAL PUBLICATIONS

Ahmad, Ijaz. 1982. *Determination of pyrazon residues in water by reversed phase high performance liquid chromatography.* J. Environ. Sci. Health. B17:253-263.

Ahmad, Ijaz. 1982. *Trace enrichment of difenzoquat in water and its determination by reversed phase high performance liquid chromatography.* Analytical Letters. 15:27-37.

Bourne, J., and Dorrance, M.J. 1982. *A field test of lithium chloride aversion to reduce coyote predation on domestic sheep.* J. Wildl. Manage. 46:235-239.

*Hawley, A.W.L., Wilhelmson, M., and Sylvan, S. 1982. *A simple device for sectioning ovaries.* J. Wildl. Manage. 46:242-249.

*Moore, J.W. 1981. *Factors influencing the species composition, distribution and abundance of benthic invertebrates in the profundal zone of a eutrophic northern lake.* Hydrobiologia. 83:505-510.

*Moore, J.W. 1981. *Influence of temperature, photoperiod and trophic conditions on the seasonal cycles of phytoplankton and zooplankton in two deep subarctic lakes of northern Canada.* Int. Revue ges. Hydrobiol. 66:745-770.

*Moore, J.W. 1981. *Patterns of distribution of phytoplankton in northern Canada.* J. Crypt. Bot. 34:599-621.

*Moore, J.W. 1981. *Seasonal abundance of Ceratium hirundinella (O.F. Muller) Schrank in lakes of different trophy.* Arch. Hydrobiol. 92:535-548.

*Moore, J.W. 1981. *Seasonal cycles of rare species of epipelic diatoms in hardwater temperature-zone stream.* Nova Hedwigia. Band XXXIV. Braunschweig. J. Cramer.

*Pagel, J.E., Qureshi, A.A., Young, D.M., and Vlassof, L.T. 1982. *Comparison of four membrane filter methods for fecal coliform enumeration.* Appl. Environ. Microbiol. 43:787-793.

*Qureshi, A.A., Flood, K.W., Thompson, S.R., Janhurst, S.M., Inniss, C.S., and Rokosh, D.A. 1982. *Comparison of a luminescent bacterial test with other bioassays for determining toxicity of pure compounds and complex effluents.* IN: Aquatic toxicology and hazard assessment. Annual Symposium on Aquatic Toxicology, 5th, Philadelphia, Pa. ASTM 179-195. (ASTM STP 766)

*Sharma, M.P., Qureshi, F.A., and Vanden Born, W.H. 1982. *The basis for synergism between barban and flamprop on wild oat (Avena fatua).* Weed Science. 30:147-152.

*Sharma, M.P., and Vanden Born, W.H. 1982. *Interaction between difenzoquat and propanil or propanil/ MCPA combinations for wild oat and green foxtail control in barley.* Can. J. Plant Science. 62:453-459.

*Experimental work not done at AEC

OTHER PUBLICATIONS

Das, N.C. 1981. *Methods Manual for Chemical Analysis of Atmospheric Pollutants.* Alberta Environmental Centre. Vegreville, Alberta. 213 pp.

Goatcher, L.G., and Qureshi, A.A. 1981. *Bibliography of cattle feedlot manure management.* Alberta Environmental Centre. Vegreville, Alberta. 53 pp. (AECV81-B3)

*Kharbanda, P.D., Howard, R.J., and Mohyuddin, M. 1981. *Effect of fungicides and cultivars on control of grey mold of greenhouse lettuce.* Report of the Committee on Horticultural Research, Canadian Horticultural Council. p. 208.

*Kharbanda, P.D., and Howard, R.J. 1981. *Control of root-knot nematodes in greenhouse cucumbers.* Pesticide Research Report, Agriculture Canada. p. 335.

*Kharbanda, P.D., and Howard, R.J. 1981. *Effectiveness of fungicides for the control of grey mold of greenhouse cucumbers.* Am. Phytopathol. Soc. Fungicide and Nematicide Tests. 36:59.

*Kharbanda, P.D., and Howard, R.J. 1981. *Effect of fungicide, pruning method and cultivar on grey mold disease of greenhouse cucumbers.* Am. Phytopathol. Soc. Fungicide and Nematicide Tests. 36:60.

*Kharbanda, P.D., and Howard, R.J. 1981. *Efficacy of mocap for control of root-knot nematodes of greenhouse cucumbers and tomatoes.* Can. J. Plant Pathology. 3:115.

Osrunn, J., and Lee, D. 1982. *Persons Involved in Environmental Research in Alberta.* Alberta Environmental Centre. Vegreville. 163 pp. (AECV82-L1)

Philip, H.G., and Herbut, M. 1981. *Control of horn flies using fenvalerate backrubber solutions.* Pesticide Research Report, Agriculture Canada. p. 174.

Philip, H.G., and Herbut, M. 1981. *Control of horn flies using tetrachlorvinphos-impregnated ear tag.* Pesticide Research Report, Agriculture Canada. p. 175.

Philip, H.G., and Herbut, M. 1981. *Control of lice using fenvalerate pour-on.* Pesticide Research Report. p. 169.

Philip, H.G., and Herbut, M. 1981. *Evaluation of rabon oral larvicide for house fly control.* Pesticide Research Report, Agriculture Canada. p. 180.

Philip, H.G. 1982. *Review of: Riegert, Paul W.* From Arsenic to DDT: A History of Entomology in Western Canada, Alta. Nat. 12(1):26-27.

*Qureshi, A.A., and Rybakowski, I.M. 1981. *Microbiological studies of various land uses in the Canadian Great Lakes drainage basin.* Ontario Ministry of the Environment. Toronto, Ontario. 125 pp.

Qureshi, A.A. 1981. *Review and evaluation of microbial test systems for determining toxicity of chemicals and effluents.* Alberta Environmental Centre. Vegreville. 35 pp. (AECV81-B2)

Qureshi, F.A., and Sharma, M.P. 1982. *A simple bioassay technique for determination of picloram residue in soil.* Abstr. Weed Sci. Soc. Amer. p. 128-129.

Qureshi, F.A., and Feddema, H.I. 1981. *Eleven abstracts on broadleaved and grassy weed control with experimental and registered herbicides in wheat and barley.* Research Report, Expert Committee on Weeds (W. Canada). 1:43-45; 2:250-251, 521-524, 604-605.

Qureshi, F.A., and Feddema, H.I. 1981. *Nine abstracts on tolerance of succeeding wheat crop to carry-over of residues of various registered and experimental herbicides (BAS 9052, TF 1169, EL 5261, ethalfluralin, trifluralin, dual 960 and M3723).* Research Report, Expert Committee on Weeds (W. Canada). 1:45-52.

Qureshi, F.A., and Feddema, H.I. 1981. *Nine abstracts on tolerance of barley to various registered and experimental herbicides (picloram, 2,4-D, propanil/ MCPA, DPX 4189, metribuzin, bromoxynil and RH 0265).* Research Report, Expert Committee on Weeds (W. Canada). 1:94-100.

Qureshi, F.A., and Feddema, H.I. 1981. *Seven abstracts on control of scentless chamomile, wild oats, green foxtail, cleavers, knarvel, and stork's bill in rapeseed.* Research Report, Expert Committee on Weeds (W. Canada). 1:240-243.

Qureshi, F.A., Feddema, H.L. 1981. *Seventeen abstracts on tolerance of succeeding rapeseed crop to carry-over of residues of various registered and experimental herbicides (diclofop methyl, M-3723, picloram, MCPA, bromoxynil, A-5633, dicamba, metribuzin, DPX 4189, linuron, 2,4-D and propanil).* Research Report, Expert Committee on Weeds (W. Canada). 1:244-256.

Qureshi, F.A., and Feddema, H.L. 1981. *Two abstracts on control of volunteer wheat and barley in rapeseed — I and II.* Research Report, Expert Committee on Weeds (W. Canada). 2:506-507.

Ramamoorthy, S. 1981. *Interlaboratory quality control study no. 7; metals, Cd, Cu, Fe, Pb, Ni, Cr, and Zn.* Alberta Environmental Centre. Vegreville, Alberta. 47 pp. (AECV81-A7)

*Reynolds, H.W., Glaholt, R.D., and Hawley, A.W.L. 1982. *Bison.* IN J.A. Chapman and G.A. Feldhammer (eds), Game, Pest and Commercial Mammals of North America. The Johns Hopkins University Press. Baltimore. pp. 972-1007.

Sandhu, H.S. (ed.), Choquette, P.J., Clanachan S., Greenhill, S., Katz, M., Lehey, D.M., Lillie, L.E., Phillips, M.S. and Sheffer, M.G. 1981. *Hydrogen sulphide in the atmospheric environment: scientific criteria for assessing its effects on environmental quality.* Associate Committee on Scientific Criteria for Environmental Quality. National Research Council of Canada. Ottawa, Ontario. NRC 18467.

*Sharma, M.P. 1981. *Common groundsel control with postemergence herbicides.* Research Report, Expert Committee on Weeds (W. Canada). 2:579.

*Sharma, M.P., Vanden Born, W.H., and McBeath, D.K. 1981. *Fertilizers and herbicides in wild oat control.* Agriculture and Forestry Bulletin, University of Alberta. Edmonton. 4(3 & 4):22-25.

*Sharma, M.P. 1981. *Seven abstracts on control of Canada thistle, Russian thistle and other grassy and broadleaved weeds in sugarbeets and corn.* Research Report, Expert Committee on Weeds (W. Canada). 1:156, 268-269, 316, 379-382; 2:579.

*Sharma, M.P., and Epp, G. 1981. *Twelve abstracts on grassy and broadleaved weed control with preplant incorporated and postemergence herbicides in corn, sugarbeets, flax, soybeans, sorghum, winter wheat, peas, lentils, potatoes and dry beans.* Research Report, Expert Committee on Weeds (W. Canada). 1:122, 165, 293-294, 316-319, 333-334, 345, 362-363, 387-389; 2:428; 3:224.

*Experimental work not done at AEC

BOARD OF DIRECTORS

Mr. W. Solodzuk (Chairman)
Deputy Minister, Alberta Environment
14th Floor Oxbridge Place
9820 - 106 Street
EDMONTON, Alberta

Mr. F.W. McDougall
Deputy Minister, Renewable Resources
Alberta Energy & Natural Resources
9915 - 108 Street
EDMONTON, Alberta

Dr. A. Olson
Assistant Deputy Minister,
Research & Operations
Alberta Agriculture
4th Floor Agriculture Building
9718 - 107 Street
EDMONTON, Alberta

Dr. H. Buchwald
Managing Director
Occupational Health and
Safety Division
Alberta Workers' Health, Safety and
Compensation
5th Floor Donsdale Place
10709 - Jasper Avenue
EDMONTON, Alberta

Dr. G.G. Cloutier
President, Alberta Research Council
7th Floor Terrace Plaza
4445 - Calgary Trail South
EDMONTON, Alberta

Mr. E.E. Kupchanko
Assistant Deputy Minister
Environmental Protection Services
Alberta Environment
14th Floor Oxbridge Place
9820 - 106 Street
EDMONTON, Alberta

Dr. R.S. Weaver
Executive Director
Alberta Environmental Centre
VEGREVILLE, Alberta

TECHNICAL ADVISORY COMMITTEE

Dr. J. Shah (Chairman)
Director,
Research Management Division
Alberta Environment
15th Floor Oxbridge Place
9820 - 106 Street
EDMONTON, Alberta

Dr. R.G. Christian
Director, Animal Health Division
Alberta Agriculture
8th Floor, Agriculture Building
9718 - 107 Street
EDMONTON, Alberta

Mr. W.D. Wishart
Wildlife Research Biologist
Alberta Energy & Natural Resources
O.S. Longman Building
6909 - 116 Street
EDMONTON, Alberta

Dr. R. Green
Director, Policy Development &
Program Evaluation
Alberta Research Council
9th Floor, 9925 - 108 Street
EDMONTON, Alberta

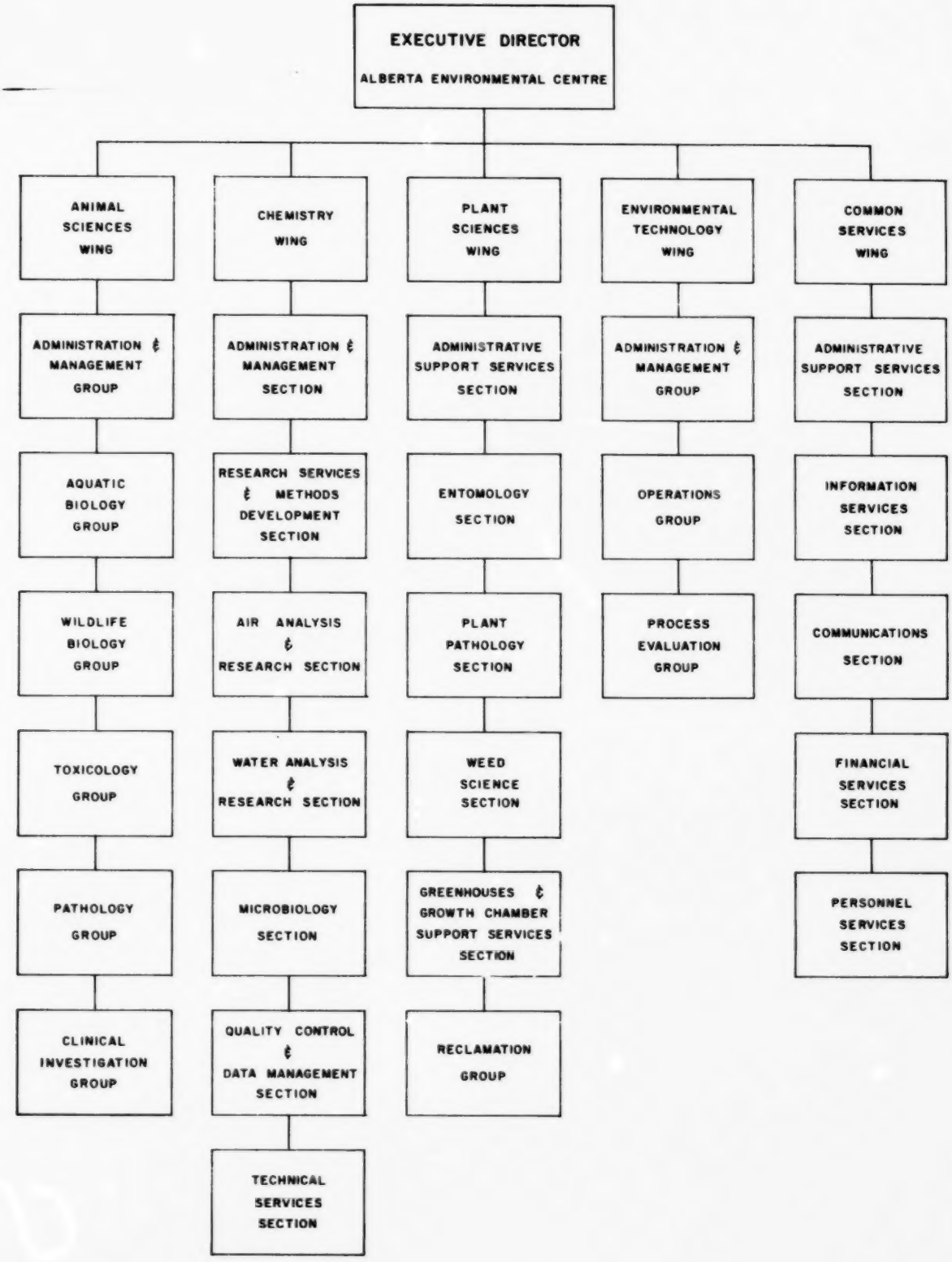
Dr. Ian Drummond
Director, Laboratory Services Branch
Alberta Workers' Health, Safety and
Compensation
10709 - Jasper Avenue
EDMONTON, Alberta

Dr. R.S. Weaver
Executive Director
Alberta Environmental Centre
VEGREVILLE, Alberta

1981-82 FISCAL YEAR EXPENDITURES

	Manpower	Supplies & Services	Grants	Fixed Assets	TOTAL
Program Support	799,945.18	668,046.81	600.00	162,402.74	$1,630,994.73
Plant Sciences	562,609.50	120,341.16	—	294,585.53	977,536.19
Chemistry	1,171,605.04	378,646.61	—	500,598.60	2,050,850.25
Animal Sciences	1,019,928.33	515,264.57	—	290,289.00	1,825,481.90
Envir. Tech.	401,221.82	174,313.38	—	380,378.94	955,914.14
TOTAL	$3,995,309.87	$1,856,612.53	$600.00	$1,628,254.81	$7,440,777.21

(This is not an audited statement.)


EXECUTIVE DIRECTOR
ALBERTA ENVIRONMENTAL CENTRE
ANIMAL SCIENCES WING
ADMINISTRATION & MANAGEMENT GROUP
AQUATIC BIOLOGY GROUP
WILDLIFE BIOLOGY GROUP
TOXICOLOGY GROUP
PATHOLOGY GROUP
CLINICAL INVESTIGATION GROUP
CHEMISTRY WING
ADMINISTRATION & MANAGEMENT SECTION
RESEARCH SERVICES & METHODS DEVELOPMENT SECTION
AIR ANALYSIS & RESEARCH SECTION
WATER ANALYSIS & RESEARCH SECTION
MICROBIOLOGY SECTION
QUALITY CONTROL & DATA MANAGEMENT SECTION
TECHNICAL SERVICES SECTION
PLANT SCIENCES WING
ADMINISTRATIVE SUPPORT SERVICES SECTION
ENTOMOLOGY SECTION
PLANT PATHOLOGY SECTION
WEED SCIENCE SECTION
GREENHOUSES & GROWTH CHAMBER SUPPORT SERVICES SECTION
RECLAMATION GROUP
ENVIRONMENTAL TECHNOLOGY WING
ADMINISTRATION & MANAGEMENT GROUP
OPERATIONS GROUP
PROCESS EVALUATION GROUP
COMMON SERVICES WING
ADMINISTRATIVE SUPPORT SERVICES SECTION
INFORMATION SERVICES SECTION
COMMUNICATIONS SECTION
FINANCIAL SERVICES SECTION
PERSONNEL SERVICES SECTION

POOR

QUALITY

ORIGINAL